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ABSTRACT

This student module on safety features for floor and wall openings and stairways is one of 50 modules concerned with job safety and health. This module suggests safeguards to protect workers from falling and tripping, and from injury caused by falling tools and materials. Following the introduction, eight objectives (each keyed to a page in the text) the student is expected to accomplish are listed (e.g., Describe fixed stairway strength and construction). Then each objective is taught in detail, sometimes accompanied by illustrations. Learning activities are included. A list of references and answers to learning activities complete the module. (CT)

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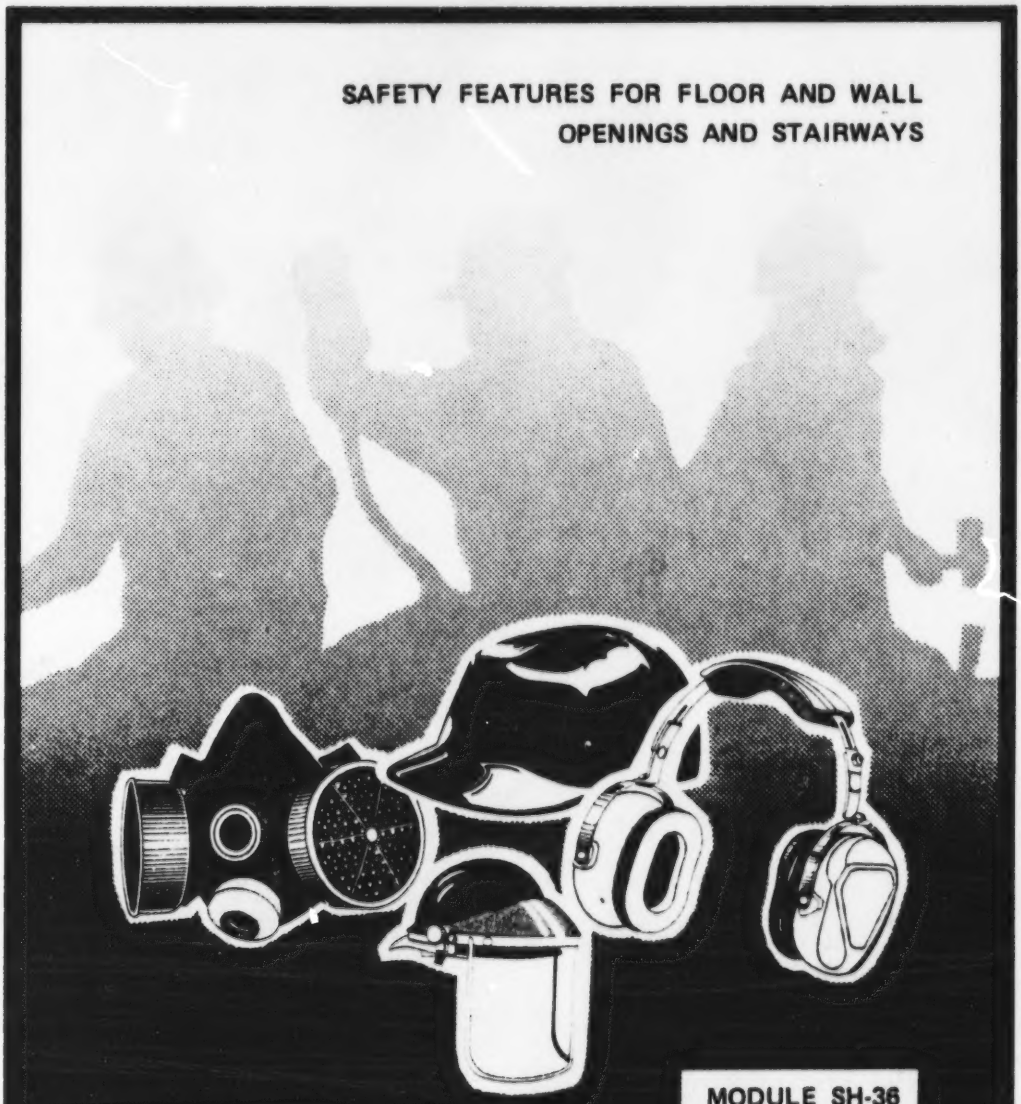
SAFETY AND HEALTH

SAFETY FEATURES FOR FLOOR AND WALL OPENINGS AND STAIRWAYS



MODULE SH-36

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INTRODUCTION

Most plants and almost all construction sites have floor openings, wall openings, and stairways, and these features are often the sites for accidents, usually falls. One-fifth of all job accidents result from falls: falling over an item, stepping in a hole, falling to a lower level. This module suggests safeguards to protect workers from falling and tripping, and the steps that should be taken to prevent injury from falling tools and materials.

The OSHAct (Occupational Safety and Health Act) requires that floor openings, wall openings, and stairways be protected by some kind of barrier. This module examines each of these three possible hazards and suggests barriers that meet OSHA standards. Since getting rid of safety hazards depends on the problems being quickly noticed, workers need to be sensitive to areas where protective guarding is absent or not good enough. Floor openings, such as pits, trapdoors, manholes, chutes, stairway and ladderway openings, and skylights should have structural guards. Railings are a must to prevent falling accidents from platforms, runways, or floors with open sides that have a drop of four feet or more.

Wall openings such as holes, windows, elevator shaft door openings, or chutes can be guarded by rails, picket fences, half doors, or similar barriers. Stairways must follow special building standards for strength and have railings for safety.

OBJECTIVES

Upon completion of this module, the student should be able to:

1. Compare and contrast standard railing with toeboard, hand railing, and stair railing. (Page 3)
2. List the different types of floor openings which should be guarded. (Page 5)
3. Explain when and where a platform should be used with regard to floor openings. (Page 8)
4. List different types of wall openings and holes which should be guarded. (Page 9)

5. State the maximum distance between a wall opening and the floor before the opening must be guarded. (Page 10)
6. State when open-sided floors, platforms, and runways must be guarded by railings. (Page 11)
7. List the types of railings which may be used on stairs having four or more risers. (Page 12)
8. Describe fixed stairway strength and construction. (Page 14)

SUBJECT MATTER

OBJECTIVE 1: Compare and contrast standard railing with toeboard, stair railing, and hand railing.

A railing is the main device for protecting persons from falling through floor or wall openings, from stairways, from platforms, or from runways. Whether the opening or open side is temporary or permanent, a protective railing or a cover must be provided. Railings can be made of wood, pipe, or steel so long as they can withstand a load of 200 pounds applied from any direction anywhere on the rail. Fiber and wire rope are not the best choice of materials for railing because they sag, but they are acceptable of kept taut.

Three kinds of railings are in general use. Standard railing (Figure 1a) refers to a vertical guard railing about 42 inches high, built along the open side of a floor or wall opening, to prevent people from falling off the edge. A standard railing must consist of a top rail, a middle rail, and an adequate number of posts. The posts are usually spaced six or eight feet apart, depending on the construction material used.

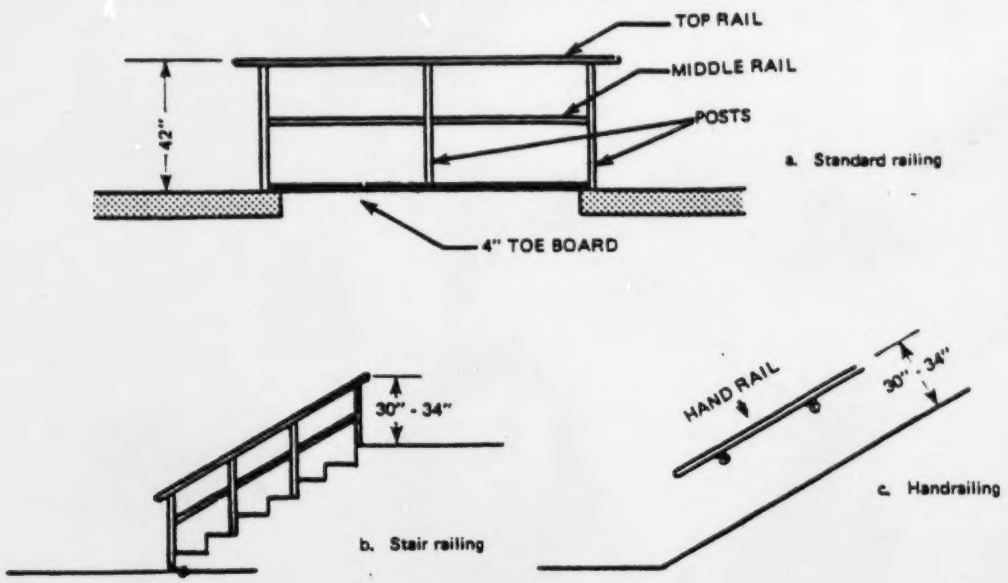

Figure 1. Three types of railing.

A stair railing (Figure 1b) is like a standard railing since it has a top rail and a middle rail anchored by posts spaced about six or eight feet apart. But its height must be 30 to 34 inches rather than 42 inches.

A handrail (Figure 1c) is simply a horizontal bar or pipe that is mounted with brackets on a wall or partition. A handrail, just like the top rail of a standard or stair railing, is meant to provide a firm handhold in case one stumbles or trips on a stairway or ramp. Handrails and top rails need to be smooth and easy to grasp. The required height for a handrail is the same as for a stair railing, 30 to 34 inches, and a handrail must be set out at least three inches from the wall.

A toeboard is a barrier at least four inches in height that is built along the open sides of a floor or wall opening or the exposed edges of a platform, runway, or ramp. A toeboard prevents materials or tools from falling through an opening to a lower level and causing injury to someone.

Floor covers are sometimes used in place of fixed standard railings to guard floor openings. Covers need to be able to carry the same load as the floor, and they must be flush — that is, even — with the surrounding floor, or nearly so.

ACTIVITY 1:*

Compare and contrast standard railing, stair railing, and hand railing by filling in the blanks of the table below.

	Standard Railing	Stair Railing	Hand Railing
Number of rails			
Strength or loadbearing capacity			
Height of railing			
Method of mounting railing			

*Answers to activities begin on page 16.

OBJECTIVE 2: List the different types of floor openings which should be guarded.

Any opening is dangerous if someone can trip over it, or fall through it, or drop something through it. Care must be taken to safeguard all such openings.

One floor opening that is necessary in many workplaces is the stairway. Standard railings must be provided on all exposed sides of the stairway opening (as shown in Figure 2) except the entrance to the stairway itself. Sometimes little-used stairways are in the path of normal foot traffic, and workers find it inconvenient to use a fixed standard railing around the stairway opening. In that case, a hinged floor opening cover may be used instead. Even a hinged floor cover must have a removable standard railing set up around the opening when a cover is not in place.

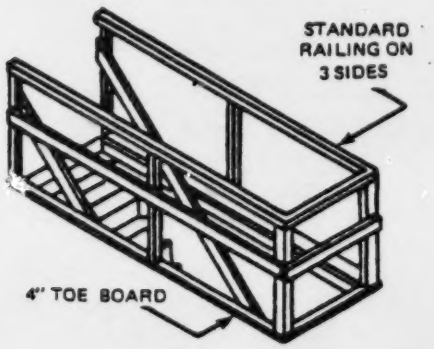

Figure 2. Stairway opening.

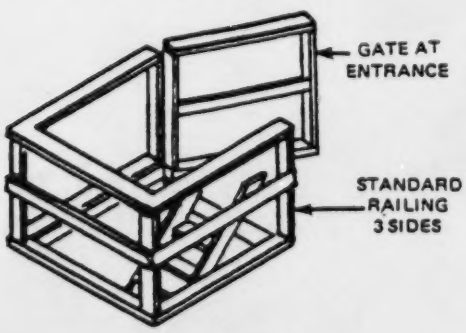

Figure 3. Ladderway opening.

Ladderway openings should be guarded in the same way as stairway openings with the extra precaution of a toeboard. Unless the ladderway is offset to prevent a worker's walking directly into the opening, a swing gate must be provided at the entrance.

Hatchways and chutes can be guarded in one of two ways. A hinged floor opening cover may be used, along with removable standard railing on all except one exposed side. In this way, if the opening is not in use, the cover can be closed, or removable top and middle rails can be put on the exposed side (see Figure 4). Another safe and acceptable way to protect workers is to provide fixed standard railings with a toeboard on two exposed sides

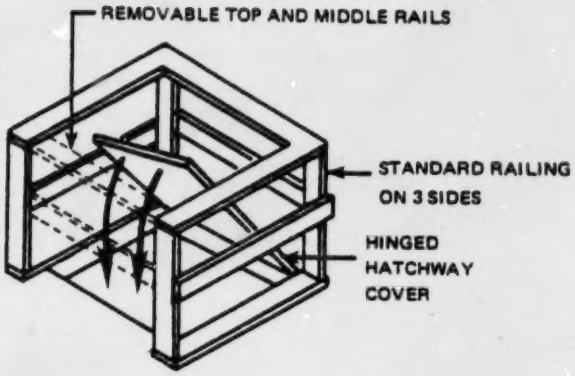

Figure 4. Hatchway of chute opening.

Figure 5. When the cover of a floor opening is off, a worker should guard the opening or fixed standard railing must be provided.

of the hatchway or chute and to use removable railings on the other two sides. Sometimes workers have to feed material into a hatchway or chute opening. Wherever this is the case, some kind of protection must be provided to prevent the worker from falling through the opening.

Skylights may be guarded by a standard skylight screen or by fixed standard railings on all exposed sides.

A floor opening cover should also be hinged in place over all pits and trapdoors. The cover must be form-fitting and able to carry the same weight as the floor around it. Whenever the cover is not closed, removable standard railings must be provided on all open sides. Otherwise, the opening must be guarded by a worker (someone other than the person working in the floor opening as shown in Figure 5) until the cover is back in place. The same alternatives, removable railings or constant attendance by personnel, must be provided for a manhole while the manhole cover is temporarily off the opening. Unlike the covers for pits, trapdoors, hatchways, and chutes, manhole covers do not have to be hinged in place.

Either standard railings or constant attendance by another worker is required for temporary floor openings also. Any other kind of floor openings over one inch wide or long have to be guarded as well. This is not only to prevent workers from tripping over such openings, but also to prevent tools or materials from falling through the holes and possibly hurting persons below. If these floor holes are in an area where people can walk into them by accident, they must be guarded by standard railing with a toeboard, or hinged floor covers, or a worker must guard the hole when the cover is off. Even floor holes that workers cannot get to because machinery, equipment, or walls block them from foot traffic must be protected by covers, and the covers must not leave openings more than one inch wide.

When floor opening covers are not the right size, or are not fastened correctly, serious injury or death can be the result. One case brought before OSHA concerned a man returning from lunch with two co-workers. All three were walking through the plant when the man stepped on a floor opening cover that had been left uncleated (unfastened). The man fell to his death. If someone had taken a minute or two to be sure that the floor opening cover was firmly in place, the accident would not have occurred.

ACTIVITY 2:

List the different types of floor openings which should be guarded.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

OBJECTIVE 3: Explain when and where a platform should be used with regard to floor openings.

Some stairway and ladderway openings need an added safety precaution. Wherever a door or a gate opens directly on a stairway, there is danger that a worker will walk through the entranceway quickly and be surprised by the stairs (see Figure 6). A platform should be provided in such cases, and this platform must be at least 20 inches wider than the space needed for the swing of the door.

Figure 6. Wherever a door or gate opens directly on to a stairway, an adequate platform must be provided.

ACTIVITY 3:

In which situations are platforms required?

a. Wherever there is a ladderway or stairway.
b. Wherever a door or gate opens directly on a stairway or ladderway.
c. Wherever a door swings out more than 20 inches.
d. Wherever workers are likely to be using the stairs quickly.

OBJECTIVE 4: List different types of wall openings and holes which should be guarded.

Any wall opening large enough or low enough for someone to fall through or knock objects through, needs protective guarding. Such openings may include windows, chutes, temporary wall openings, holes, and even doorways. The important thing to keep in mind is that wall openings from which there is a drop of four feet or more must be guarded. Guarding can be supplied by a rail, picket fence, half door, or a similar barrier.

It is permissible to use a removable guard over a wall opening, but it is better if the guard is hinged or mounted in some way so that it is easy to replace. A grab handle on each side of the opening, about four feet above floor level, must also be provided. Wherever there is a danger of falling materials injuring workers on a lower level, a toeboard or paneling is required. A toeboard is the standard protection necessary for chutes, wall openings, and holes. Temporary wall openings must be guarded also, but the guards do not have to be of standard construction.

Even if there is a door on a wall opening, precautions have to be taken. A door which opens on to a drop of four feet or more needs the added precautions of grab handles and a guard (Figure 7). Any guard used must be kept in place when the opening is not being used. Sometimes there is a platform outside the wall opening, put there to allow for easier lifting and handling of materials. If this platform has a railing, then there is no need for grab handles or a guard over the opening. Outside door openings that are used for lifting equipment or material may be made safer if a "NOT AN EXIT" sign is posted on or over the door.

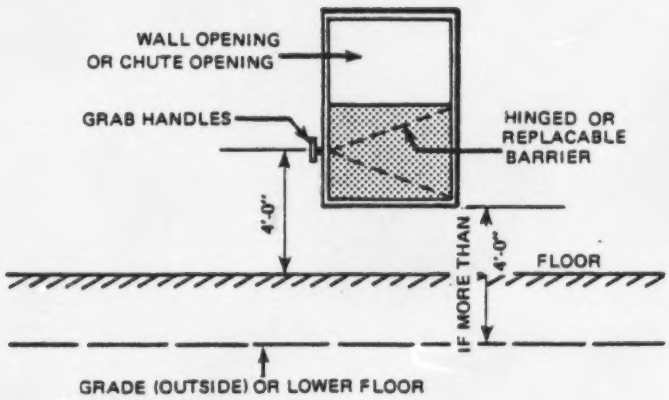

Figure 7. Wall or chute opening.

ACTIVITY 4:

1. List the different types of wall openings that must be guarded.
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____
2. Fill in the blank.
   Any wall opening from which there is a drop of _____ feet or more must be guarded.

OBJECTIVE 5: State the maximum distance between a wall opening and the floor before the opening must be guarded.

Windows at stairway landings, platforms, or balconies require guarding if they are four feet or more from the ground or floor outside and if the bottom of the window is less than three feet above the platform or landing. Slats, grillwork or standard railing may provide the necessary protection.

In some cases, the bottom of a window opening may be below the landing or platform, thereby creating a danger of materials falling through the window and injuring those who are on the lower level. If the bottom edge of the window or wall opening is less than four inches above the floor, and there is a drop of five feet or more to a lower level below the window outside, then a standard toeboard or an enclosure screen must be used.

ACTIVITY 5:

State the maximum distance between a wall opening and the floor before the opening must be guarded. _____

OBJECTIVE 6: State when open-sided floors, platforms, and runways must be guarded by railings.

Open-sided floors, platforms, and runways that are raised four feet or more above the floor or the ground next to them must be guarded by standard railing or the equivalent. Entrances to ramps, stairways, or fixed ladders may be left exposed. A platform simply means any raised passageway, such as a footwalk along shafting or a walkway between buildings.

There are three situations in which a toeboard, an enclosure screen, or paneling is needed in addition to the standard railing. Wherever an open-sided floor, platform or runway is placed so that, below the open side (1) people can pass, (2) moving machinery is stationed, or (3) equipment is placed with which falling materials could make hazardous contact, then a toeboard, an enclosure screen, or paneling is needed. In the case of a runway, a toeboard is needed if there is any chance of tools, machine parts, or materials being used on the runway. Workers need to be very careful of runways or platforms which are above or next to dangerous equipment of any kind, such as pickling or galvanizing tanks, degreasing units or similar hazards (Figure 8). In these situations, regulation, along with common sense, requires standard railing and toeboard regardless of the height of these open-sided floors.

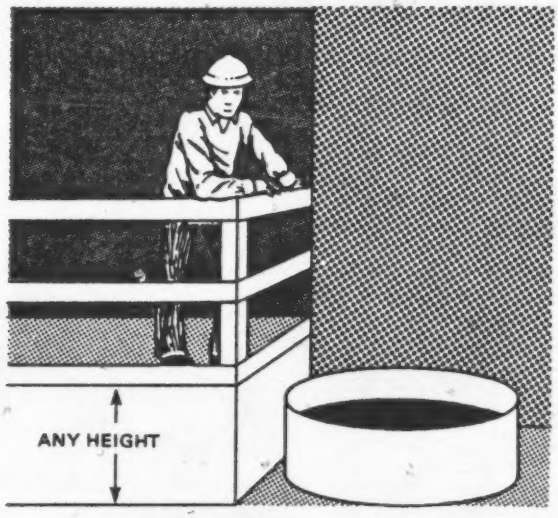

Figure 8. No matter what their height, runways and platforms that are next to dangerous equipment of any kind need to have standard railing and toeboard.

Runways are sometimes used for servicing machinery or doing other things for which one open side is needed. The railing can be left out in such situations, so long as the runway is at least 18 inches wide. Where workers entering a runway are exposed to electrical equipment or open vats or any dangers other than falling, then additional guarding of the equipment may be necessary. In other words, if the runway

cannot be provided with a rail on both sides because operating conditions require one open side, then the hazard below needs guarding in some other way. For example, an open vat may need to be covered.

Some other accident prevention measures for platforms, runways, and ramps are not legally required, but are good ideas all the same. Ramps and runways can be made safer by being covered with rough coatings or adhesive strips for safe footing. Platforms and runways on which materials are stacked or stored may be better protected by an enclosure screen than by a railing and toeboard.

ACTIVITY 6:

State the two general situations in which open-sided floors, platforms, and runways must be guarded.

1. _____
2. _____

OBJECTIVE 7: List the types of railing which may be used on stairs having four or more risers.

Stairways are a major source of injuries. Stairway accidents are best prevented by constructing safe stairs and including standard railings. Workers need to be aware of stairway safety factors and be able to recognize a stairway hazard. In Figure 9 below, the different parts of a stairway are shown and labeled with the terms used in this discussion.

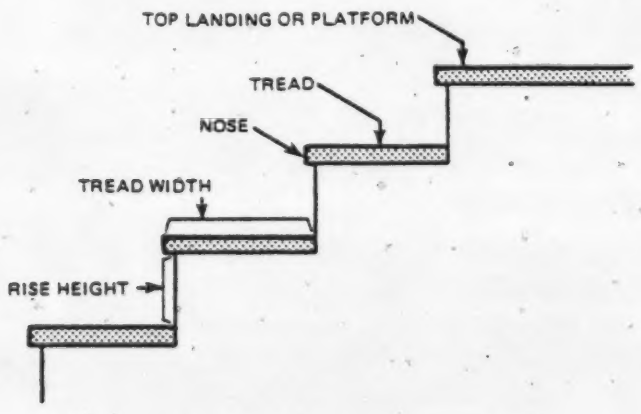

Figure 9. Parts of stairway.

The tread refers to the part of the step that is stepped on. Tread width is the distance from the front to the back of the tread, including the nose when there is one. The rise of the step is the height from the top of the tread to the top of the next higher tread. If there is no solid

connection joining the back of one tread to the front of the next higher tread, the stairway is described as having open risers. A stairway platform is a landing that provides a break in a run of stairs.

Every flight of stairs having four or more risers must be equipped with stair railings or handrails. Table 1 below shows the railing requirements for stairways according to their widths. "Enclosed" means that there is a wall on one or both sides of the stairway.

TABLE 1. RAILING REQUIREMENTS FOR STAIRWAYS.

Width of Stairway	Railing Requirements
Less than 44 inches	• If both sides are enclosed, there must be at least one hand rail, preferably on the right side. • If one side is open and one side enclosed, there must be at least a stair railing on the open side. • If both sides are open, one stair railing must be on each open side.
44 to 88 inches	• A handrail is required on each enclosed side. • A stair railing is required on each open side.
More than 88 inches	• One handrail is required on each enclosed side. • One stair railing is required on each open side. • One middle stair railing must be placed about midway of the width.

The ends of all railings, stair railings and hand railings, should be turned toward the wall or otherwise made so they do not stick out.

Winding stairs are usually put around tanks and similar round structures. A handrail is required for all winding stairs, and it should be offset in such a way that workers are not able to walk on any part of the tread which is less than six inches wide.

Winding and spiral stairways require extra caution to be taken by the user, because the treads are wider on the outside than on the inside. For

this reason, installing winding stairways is not permitted around tanks or structures that are less than five feet in diameter. Spiral stairways should be installed only where it is not practical or possible to provide a regular stairway.

ACTIVITY 7:

Match the type of stairway with its railing requirements.

_____	1. Stairway more than 88 inches wide with both sides enclosed.	a.	A handrail on the open side and stair railing on the closed side.
_____	2. Stairway more than 88 inches wide with both sides open.	b.	Handrails on each side and a stair railing at the midpoint of the stairs.
_____	3. Stairway less than 44 inches wide, with both sides closed.	c.	One handrail, preferably on the right side descending.
_____	4. Stairway 44 to 88 inches wide with both sides open.	d.	Stair railing on both sides.
_____	5. Stairway 44 to 88 inches wide with one side open and one side closed.	e.	Stair railing at both sides and a stair railing at the midpoint of the stairs.

OBJECTIVE 8: Describe fixed stairway strength and construction.

Employers should provide fixed stairways wherever work operations require regular travel between levels. Wherever raised equipment needs routine or daily attention such as gaging, inspection, or maintanance, fixed stairs are the best way to get to such equipment. Fixed stairs are usually better than fixed ladders where workers may be carrying tools or equipment by hand, and where they may be exposed to harmful substances.

All fixed stairways must be built to carry five times the expected live load, and they must be able to carry safely a minimum moving concentrated load of 1000 pounds (Figure 10). Other guidelines are listed below:

- Stair width must be 22 inches for regular stairs, and 28 inches for stairs which provide an exit.

- Vertical clearance must be seven feet for regular stairs and 7 1/2 feet for exit stairs.
- The angle of stairway rise must be between 30 and 50 degrees.
- Rise height and tread width must be uniform.
- Treads must be reasonably slip-resistant.
- Every tread and landing must have a nose which overhangs the lower riser by one-half to one inch. The nose (or leading) edge must be even from one end to the other. (Stairways of bar welded grating treads are also acceptable, although they do not have nosings.)

Any riser height and tread width is allowed if it results in a slope from 30 to 50 degrees. A tread width of at least 9 1/2 inches and a riser height of between five and eight inches are recommended by some safety experts. Stairs with treads less than nine inches wide must have open risers.

Figure 10. Fixed stairways must be able to carry a minimum moving concentrated load of 1000 pounds.

Stairway landings are an important safety feature. OSHA regulations warn against long flights, but do not specify minimum length. Some authorities recommend platforms every tenth or twelfth tread. These stairway platforms should be at least 30 inches in length measured in the direction of travel.

Other suggestions for safer stairs are (1) to have good lighting of stairways, (2) to install covering over outdoor stairs to keep off rain, ice and snow, and (3) to install fireproof partitions and doors to keep flames from spreading by way of stairways.

ACTIVITY 8:

List the stairway requirements for load capacity, width, and incline.

1. _____
2. _____
3. _____

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National Safety Council. Accident Prevention Manual for Industrial Operations. 7th ed. Chicago: 1978.

U.S. Department of Labor. General Industry. Revised 1979. OSHA Safety and Health Standards (29 CFR 1910).

ANSWERS TO ACTIVITIES

ACTIVITY 1

Number of rails – 2, 2, 1.
Strength – 200 pounds, 200 pounds, 200 pounds.
Height – About 42 inches, 30-34 inches, 30-34 inches.
Method – posts, posts, brackets.

ACTIVITY 2

1. Stairways.
2. Ladderways.
3. Hatchways.
4. Chutes.
5. Skylights.
6. Pits.
7. Trapdoors.
8. Manholes.

9. Floor holes.
10. Temporary floor openings.

ACTIVITY 3

b.

ACTIVITY 4

1. a. Windows.
   b. Wall openings.
   c. Wall holes.
   d. Chutes.
   e. Temporary wall openings.
2. Four feet or more.

ACTIVITY 5

Three feet.

ACTIVITY 6

1. Where there is a drop of four feet.
2. Where the platform is next to dangerous equipment or people.

ACTIVITY 7

1. b.
2. e.
3. c.
4. d.
5. a.

ACTIVITY 8

1. 1000 pounds, and five times the expected live load.
2. 22 inches.
3. 30 to 50 degrees.